Positional allophony of ejective stops: A case study of Georgian

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1. Background

Different phonetic realizations of ejectives have been documented in various languages.

Strong ejectives: Navaho (Lindau 1984), Tigrinya (Kingston 1985)
Long VOT, periodic voicing at vowel onset

Weak ejectives: Hausa (Lindau 1984), Quiché (Kingston 1985)
Short VOT, glottalization at vowel onset

Georgian has strong and weak ejectives in different prosodic positions (Wysocki 2004, Vicenik 2008)

Hypothesis
Acoustic differences in the production of ejectives reflect a different realization of the laryngeal constriction gesture, estimated from onset of oral release to onset of modal vowel phonation

How is the laryngeal constriction gesture affected during the production of ejectives in different prosodic positions?

2. Expectations

Few studies on positional allophony in non-pulmonic stops, but we might expect the following modulations of the duration and/or strength of the laryngeal constriction gesture:

DURATION: Longer gesture in word-initial position and shorter gesture in intervocalic position

STRENGTH: Tighter constriction during a longer gesture

3. Method

- **Data**

Speakers: 1 male, 1 female

3 places of articulation: /p' – t' – k'/

2 conditions: Word-initial and intervocalic positions

75 words of 2-3 syllables in carrier sentences

463 sequences [C'V]

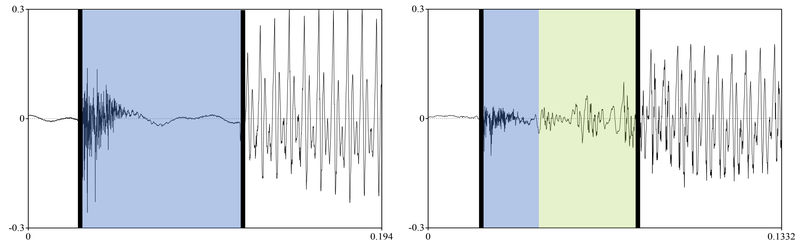
- **Units**

DURATION of the laryngeal constriction gesture as measured from the oral burst until modal voicing in the vowel (Oh et al. 2017)

STRENGTH of the gesture is estimated from the proportion of silence over glottalization during the gesture

- **Two examples** in word initial position

DURATION:	~90ms	~60ms
STRENGTH:	strong (no voicing = 100%)	weaker (no voicing = 32%)



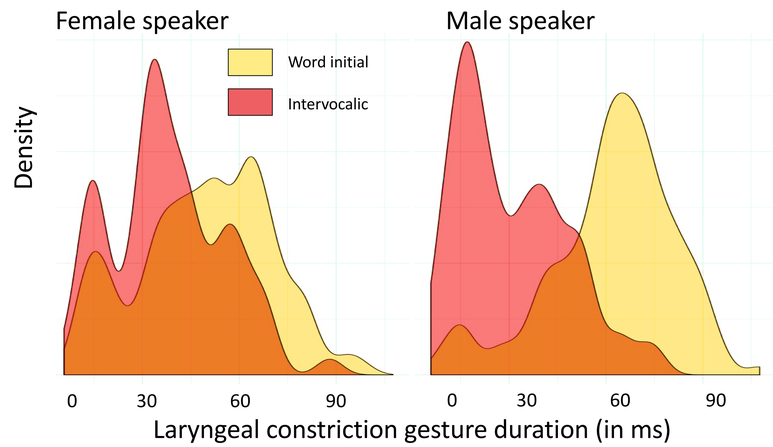
4. Results (a): Duration of the gesture

The laryngeal constriction gesture is significantly shorter in intervocalic position

Mean duration in word-initial position: 49.17ms (F speaker), 61.87ms (M speaker)

Mean duration in intervocalic position: 37.82ms (F speaker), 30.86ms (M speaker)

Difference between the mean values:
Female speaker: -11ms
Male speaker: -21ms



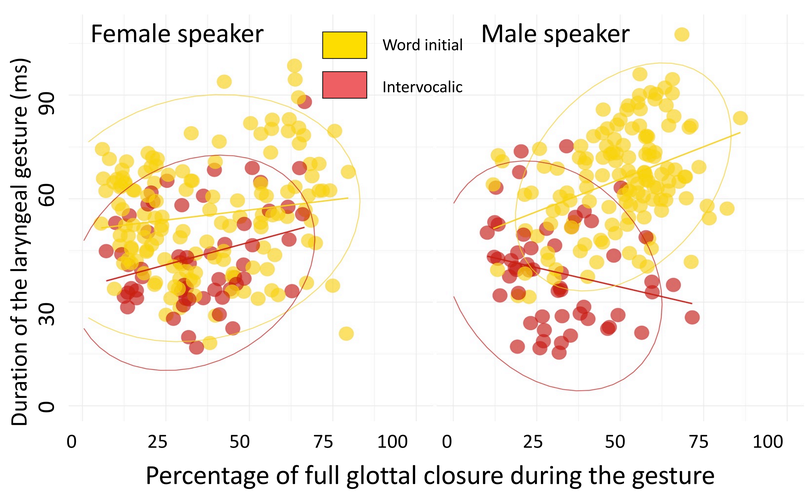
5. Results (b): Relation between strength and duration of the gesture

F speaker shows no effect of position.
M speaker has a stronger gesture in word-initial position.

Mean % of silence in word-initial position: 60.0% (F speaker), 75.9% (M speaker)

Mean % of silence in intervocalic position: 64.8% (F speaker), 62.9% (M speaker)

For M speaker:
In word-initial position:
longer DURATION => greater STRENGTH
In intervocalic position:
longer DURATION => lesser STRENGTH



6. Conclusion

Positional allophony in Georgian ejectives manipulates DURATION and STRENGTH of the laryngeal constriction gesture

Both speakers have strong and weak positional allophones: F speaker uses DURATION only, while M speaker uses DURATION and STRENGTH.

Future research:
Collect data from more speakers to determine

- if one or both of the parameters are used in positional allophony
- if there is inter-speaker variability

Selected references: Kingston, John. 1985. *The phonetics and phonology of the timing of oral and glottal events*. Ph.D. dissertation, UC Berkeley. / Kingston, John. 2005. The phonetics of Athabaskan tonogenesis. *AMSTERDAM STUDIES IN THE THEORY AND HISTORY OF LINGUISTIC SCIENCE SERIES 4, 269, 137*. / Lindau, Mona. 1984. Phonetic differences in glottalic consonants. *Journal of Phonetics* 12, 147–155. / Oh, Miran, et al. 2017. "Tracking larynx movement in real-time MRI data." *The Journal of the Acoustical Society of America* 142.4: 2579. / Vicenik, Chad. 2008. Acoustic study of Georgian stop consonants. *UCLA Working Papers in Phonetics* 107(1): 1–30. / Wysocki, Tamra. 2004. *Acoustic analysis of Georgian stop consonants and stop clusters*. Ph.D. dissertation, University of Chicago.